Linking Micro and Macro: Welfare Effects of Trade Policy in General Oligopolistic Equilibrium

Inger Sommerfelt Ervik* Christian Soegaard†

28th August 2015

AN UPDATED VERSION OF THIS PAPER WILL BE AVAILABLE ON FRIDAY 4TH SEPTEMBER
THIS PAPER IS PRELIMINARY – PLEASE DO NOT CITE

Abstract

Strategic trade policy has been studied extensively in the literature since Brander (1981) and Brander and Spencer (1981). Conventionally, optimal import tariffs serve to improve a country's terms of trade and shift profits towards its domestic market at the expense of foreign trade partners. These models are thoroughly embedded in microeconomic theory, and generally it has not been difficult to arrive at explicit closed form solutions for the relevant policy variables. We argue, however, that the micro-level welfare criteria used to arrive at the optimal policy in the oligopolistic strategic trade policy framework ignore important feedback that materialises through economy-wide general equilibrium effects. In a two-country general oligopolistic equilibrium (GOLE) model we introduce an omniscient policy maker who acknowledges and responds to the macroeconomic impacts of policy changes that occur at the micro-level. We also introduce a so-called macro-blind policy maker which allows for a convenient comparison with existing literature. We begin with a featureless economy where everything is symmetric. A comparison of the tariffs chosen by the two types of policy maker reveals that the macro-blind policy-maker underestimates the unilateral gain from the import tariff. Since the featureless economy offers no gains from trade, the omniscient policy maker uses trade policy to raise its country's share in world consumption relative to a fixed production. This trade war continues until trade is eliminated. The macro-blind policy does not acknowledge its impact on aggregate consumption and thus the trade war stops when the perceived microeconomic welfare is maximised. Our result stands in contrast to Dixit and Grossman (1986) that finds that the optimal tariff in general equilibrium is zero. This is because the GOLE model, unlike earlier models of oligopoly in general equilibrium, allows for income effects through the marginal utility of income.

*Department of Economics, University of Bergen, Norway, Email: Inger.Ervik@econ@uib.no
†Department of Economics, University of Warwick, Coventry CV4 7AL, UK. Email: C.Soegaard@warwick.ac.uk.

Keywords: oligopoly, general equilibrium, trade policy.

JEL classification: ??.

1 Introduction

Economics has traditionally been separated into the two disciplines of micro and macro. While micro economists look at individuals and firms, macro economists look at the big picture. The layperson would reasonably assume that policy decisions are taken by mainly considering the second discipline. Yet, within the field of strategic trade policies, trade and industrial policies have to a large extent been analysed based on micro frameworks, while the link to macro through general equilibrium effects have to a too large degree been neglected.

The micro founded policies give some valuable insights even though they are based on incomplete information. We argue, however, that although this might be true, basing policies on micro insight alone can be have serious short-comings. Such policies can in fact have adverse effects on welfare at the macro level. A fully informed policy-maker would recognise that besides having an impact on the production at the firm or industry level, a tariff or a subsidy will have general equilibrium effects both trough adjustments in income and factor prices. In this paper we will demonstrate the difference between micro founded and fully informed strategic trade policies, and shed some light on how important the distinction is.

One reason macro effects have been largely neglected in the literature on strategic trade policy is that the field has sprung out of microeconomic models which have lacked appropriate tools to comprise macro effects in the theory. The footing for the field was works on the concept of reciprocal dumping under imperfect competition (Brander 1981, Brander and Krugman, 1983). This is a partial equilibrium phenomenon, and thus, the surge of interest on the topic in the early 1980s was concentrated around microeconomic matters. Brander and Spencer (1981) presented the ground-breaking notion on how, under imperfect competition, a government may have incentives, and means, to manipulate strategic interaction between domestic and foreign firms. They prove how a tariff in a particular market gives domestic firms an advantage and thus move them closer to a Stackelberg leader output level (Brander and Spencer, 1984). In addition these models also demonstrate how a tariff can be used to improve the terms of trade of a country at the expense of trading partners. The possibility that an import tariff is capable of accomplishing this task goes back to Johnson (1953). The same mechanism ensures that subsidies on export can be profitable even though this in effect means subsidising foreign consumption, and abating the home country's terms of trade (Brander and Spencer, 1985). While these contributions have been seminal to our understanding of trade policy, we argue they do not provide a complete account of the effect of such policies.

The basis for strategic trade policy is that rents may be interfered with because of imperfections in the market. The principle for gains from strategic trade policies is to try and capture as large as possible a part of the profits in the market through manipulating the sequence in the strategic game between firms. This principle works seamlessly in partial equilibrium, but not necessarily in general equilibrium, and ignoring this will result in suboptimal policies. According to Krugman (1987) "to pursue a strategic trade policy successfully, a government must not only understand the effects of its policy on the targeted industry, which is difficult enough, but must also understand all the industries in the economy well enough that it can judge that an advantage gained here is worth advantage lost elsewhere".

The toil of obtaining the true optimal policies is considerable, the amount of information needed is immense. Even so, as will become apparent, ignoring general equilibrium issues renders strategic trade policy inadequate at best, destructive at worst. This is why it is important to explore the subject in the light of all relevant factors. Founding a policy in a micro level analysis, and including macro level effects has proven to be a challenging exercise not only applied, but also theoretically. Even though the problem has been out in the open for near 30 years, it still has been difficult do construct a framework suitable to address it.

One approach by Dixit and Grossman (1986) includes part of the macro level effects by endogenising factor prices. They demonstrate that when input factors are rigid or fixed and subsidies increase demand for inputs, factor prices will increase in all sectors. This implies that subsidising one sector means taxing all the others. However, even after taking this into account, the link to macro is not complete as domestic consumers are abstracted away, and income effects are absorbed by a numraire good. We want to stress that the picture is not complete until this included. In bilateral trade, one must recognise that the two countries are both consumers and exporters. Therefore, obtaining monopoly rents from a trade partner will affect foreign demand for import. Neglecting this duality will lead to the mistaken notion that it is possible to obtain profits from the trade partner without consequences for own export. Including income effects demonstrate a new dimension to the mistakes of macro blind policy maker.

While a suitable framework was not developed in the 1980s when the principle strategic trade policy was first explored, this is no longer the case. Neary (2010) promptly argues that the oligopolistic trade theory has been an incomplete theory in the sense that is not embedded in general equilibrium, and thus cannot look at the link between factor and goods markets in a satisfactory way. By constructing an economy where each market is oligopolistic and the economy is a continuum of markets, Neary (2003a, b, 2009) developed General Oligopolistic Equilibrium (GOLE). The key to the model is that the construction ensures that each firm is large in its own industry, but infinitesimally small in the economy as a whole. This way every individual participant in each market act strategically in the market they are in, but individual firm behaviour will have no effect on the general equilibrium.

With the introduction of general equilibrium, new insights on the subject of strategic behaviour has become available. Koska and Stahler (2011), Zotti and Locke (2012) and Colacicco (2012) use GOLE type frameworks and explore the subject, however, they have focused on issues concerning the production side, and have simplified the demand side of general equilibrium.

In this paper we focus on general versus partial equilibrium. Besides being suited for linking micro and macro effects of strategic trade policies, this framework allows us to obtain the optimal policy as set by a fully informed policy-maker. Moreover, the framework easily allows us to relate the prior literature on micro-founded trade policy to a new a more sophisticated macroeconomic strategic trade policy; this is done by assuming a policy maker that only acknowledges industry specific effects, namely a macro-blind policy maker.

Eaton et. al. (2012) rightfully point out that the continuum approach can be inadequate because of some of the restrictions it implies. Most importantly for us is the restriction that nothing that happens in one single market can have effects on the aggregate economy. This is crucial to us as it is what makes modelling the distinction between partial and general equilibrium effects feasible, but it does have some peculiar implications. A subsidy in a single industry will increase production in that industry, but will not affect factor prices at the macro level. Intuitively, one might think that this means that welfare can be increased at no cost. However, because the industry is so small, aggregate production will in fact not increase, and this is not a very intuitive result. Nonetheless, we feel confident that this approach is a good one for our purpose as it coincides with the traditional micro approach, and does not conflict with demonstrating our general point on how a misjudgement of general equilibrium effects will cause the macro blind policy maker to implement a suboptimal subsidy.

Our approach is to decompose the difference between the micro based optimal tariff, and the optimal tariff obtained using full information by using different scenarios. We do this to separate the mechanisms at play, and thereby spell out the distinction between the general equilibrium spill-over effects, and the consequences of neglecting them. To get a tractable model we need to make some simplifications, particularly we assume that aggregate world production is fixed, making it impossible to gain from trade. This will make the economic landscape displayed less realistic. Because our aim is to demonstrate specific flaws to policies that does not take general equilibrium effects into account, and because we know the results will prevail - though less visible - in a more elaborate model, this sacrifice is a necessary one that we are willing to make. We stress that the simplifications will not be the driving force of our findings, rather what makes us able to expose them. We will discuss this in further detail once the implications of the abstraction have been established.

The paper is divided into two main parts. The first part display a featureless mode constructed to relate the macro blind policy maker to literature, and mainly Brander and Spencer (1981) and Dixit and Grossman (1985). We use a simplified version of GOLE(Neary 2003b, 2003c) with identical firms in all sectors in an open economy. Here we show that in addition to factor market effects, income effects are important. A general equilibrium trade model without features, and no gain from trade, is very limiting outside this context. We are therefor working on a second part where we include features, we assume different sectors within a country, and apply different technologies in the two sectors, (Neary 2003b, 2009), and thereby allow the policy to affect total production. Here, an additional consideration of allocating production between sectors in an optimal way must be made by the policy-maker. Here we evaluate the consequences of being macro blind in an economy where a policy should exploit real gains from trade.

2 The model

We assume there are two countries called Home (h) and Foreign (f), and a continuum of industries, $z \in [0, 1]$, each producing one homogeneous good. In every industry there are n symmetric firms. Firms are relatively large in their own industries, and they have market power in their choice of output, which is determined in a Cournot fashion. Each firm, however, represents an infinitesimal part of the economy, and for this reason it treats economy-wide variables parametrically. We assume that unspecified barriers prevent entry such that firms make abnormal profits in equilibrium. All income accrues to the aggregate household, and labour is the only factor of production. We assume that one unit of labour yields $\theta_h(z)$ units of output in h in industry z, and similarly, $\theta_f(z)$ denotes f's labour requirement for industry z. We also assume that markets are segmented so that firms compete by choosing quantities in each country. Preferences in country h are represented by an additively separable utility function defined over the z goods with each sub-utility function quadratic:

$$U_h = \int_0^1 \left(aQ_h(z) - \frac{1}{2} bQ_h(z)^2 \right) dz, \tag{1}$$

where $Q_h(z) \equiv nq_{hh}(z) + nq_{hf}(z)$ denotes consumption of good z in country h, with $q_{hh}(z)$ being consumption of goods produced by domestic firms supplying the domestic market h and $q_{hf}(z)$ being consumption of goods produced by foreign firms supplying h. Preferences in country f are symmetric, and they can be expressed by simply exchanging h and f in (1). Utility is maximised subject to the following budget constraint:

$$\int_0^1 P_h(z) Q_h(z) dz \leq I_h,$$

where $P_h(z)$ is the price of good z in h, and I_h is aggregate income. The first-order conditions for the consumer's optimisation problem give the following inverse demand functions for each good z:

$$P_h(z) = \frac{1}{\lambda_h}[a - bQ_h(z)], \qquad \text{with} \qquad \lambda_h(P_h(z), I_h) = \frac{a\mu_h - bI_h}{\sigma_h^2}. \tag{2}$$

λ_h is marginal utility of income, or the Lagrange multiplier associated with the budget constraint, and μ_h and σ_h^2, respectively, are the first and second moments (mean and "uncentred variance") of prices, given as:

$$\mu_h = \int_0^1 P_h(z) dz, \qquad \text{and} \qquad \sigma_h^2 = \int_0^1 P_h(z)^2 dz.$$

Since firms treat the economy-wide variable λ_h parametrically, they perceive demand functions as linear.

We assume that there are no transport costs in this model, but each country is able to impose a specific tariff on imports from the other country. Let $\tau_h(z)$ denote the sector-specific tariff imposed by country h on imports from country f, and similarly let $\tau_f(z)$ denote country f's specific tariff. Firms incur marginal costs which are paid in units of labour. The wage rate in country h is denoted w_h and that in country f is w_f. Since exporters face tariffs the effective marginal cost of exporting becomes $\theta_h(z)w_h + \tau_f(z)$ for home firms exporting to f, and $\theta_f(z)w_f + \tau_h(z)$ for foreign firms exporting to h.

Both import tariffs and competitive wages are determined endogenously, the manner in which and order of which are discussed in detail below. For now it suffices to note that firm outputs are always determined last. Hence, firms take both wages and tariffs as given when setting Cournot outputs.

We index firms in industry z by $i = 1, ..., n$. The profits of firm i in industry z in h is given by the sum of its profits in its domestic and export markets,

$$\pi_{hi}(z) = \pi_{hhi}(z) + \pi_{fhi}(z) = [P_h(z) - \theta_h(z)w_h]q_{hhi}(z) + [P_f(z) - \theta_h(z)w_h - \tau_f(z)]q_{fhi}(z), \tag{3}$$

and the equivalent expression for profits of firm i in industry z in country f is given as

$$\pi_{fi}(z) = \pi_{ffi}(z) + \pi_{hfi}(z) = [P_f(z) - \theta_f(z)w_f]q_{ffi}(z) + [P_h(z) - \theta_f(z)w_f - \tau_h(z)]q_{hfi}(z). \tag{4}$$

Maximising (3) and (4) for the optimal choices of $q_{hh}(z)$ and $q_{hf}(z)$ using the inverse demand function (2), we can solve for the best-reply functions of a domestic and a foreign firm, respectively, in industry z in country h:

$$q_{hhi}(z) = \frac{a - b[q_{hh\neg i} + q_{hf}(z)] - \lambda_h\theta_h(z)w_h}{2b}; \tag{5}$$

$$q_{hfi}(z) = \frac{a - b[q_{hh}(z) + q_{hf\neg i}(z)] - \lambda_h[\theta_f(z)w_f + \tau_h(z)]}{2b}, \tag{6}$$

where $q_{hh\neg i} = \sum_{\substack{j=1\\j\neq i}}^{n} q_{hhj}$, $q_{hf\neg i} = \sum_{\substack{j=1\\j\neq i}}^{n} q_{hfj}$, $q_{hf}(z) = \sum_{j=1}^{n} q_{hhj}(z)$ and $q_{hh}(z) = \sum_{j=1}^{n} q_{hhj}(z)$. Similar best-reply functions can be found for the foreign market, and by symmetry these expressions can be found by exchanging h and f in (5) and (6). Using the best-reply functions (5) and (6), industry outputs in subgame-perfect Nash equilibrium can be determined as functions of wages and tariffs:[1]

$$q_{hh}(z) = n\left(\frac{a + \lambda_h[n[\theta_f(z)w_f + \tau_h(z)] - (n+1)\theta_h(z)w_h]}{b(2n+1)}\right); \tag{7}$$

$$q_{hf}(z) = n\left(\frac{a + \lambda_h[n\theta_h(z)w_h - (n+1)[\theta_f(z)w_f + \tau_h(z)]]}{b(2n+1)}\right); \tag{8}$$

Summing up the quantities over all domestic and foreign firms within each industry in the home market (7) and (8), and similarly for the foreign market by using the foreign equivalents of (7) and (8), yields,

[1] We have used symmetry of firms within each industry to obtain the equilibrium outputs.

respectively, expressions for total industry output sold in country h and country f:

$$Q_h(z) = q_{hh}(z) + q_{hf}(z) = n\left(\frac{2a - \lambda_h[\theta_h(z)w_h + \theta_f(z)w_f + \tau_h(z)]}{b(2n+1)}\right); \tag{9}$$

$$Q_f(z) = q_{ff}(z) + q_{fh}(z) = n\left(\frac{2a - \lambda_f[\theta_f(z)w_f + \theta_h(z)w_h + \tau_f(z)]}{b(2n+1)}\right). \tag{10}$$

3 Trade policy

In literature on strategic trade policy, optimal tariffs are determined by maximising welfare at the micro level, and the link to welfare in general equilibrium is ignored. We believe that in the real world, it is very likely that trade policy is determined at the micro level subject to lobbying by special interests representing the industry. This is especially the case with anti-dumping policies. In many developing countries where tariff revenue is still a major source of government revenue, this is less likely to be the case. In this paper, we consider two types of policy-maker: one chooses the tariff which maximises welfare in each industry, taking as exogenous the macroeconomic (or economy-wide) impact of the tariff levels; the other policy-maker acknowledges and responds to macroeconomic variables when setting sector-specific trade policies. We shall refer to the first type of policy-maker as macro-blind and the second as omniscient.

While the macro-blind policy maker ignores the macroeconomic impact of its actions, we can certainly study the impact of its chosen tariff level on the macroeconomy. In order to proceed we will consider a more specific setup, where we partition the economy into two sectors. Sector 1 is the set of industries on the interval $S_1 \in \left[0; \frac{1}{2}\right]$, and Sector 2 is the set of industries on $S_2 \in \left(\frac{1}{2}; 1\right]$. We assume that country h has a comparative in Sector 1. Specifically, we assume that the unit labour requirement for all industries in Sector 1 in country h is θ, whereas the unit labour requirement for country f is 1 for that sector. Symmetrically, the unit labour requirement in Sector 2 is θ in country f and 1 in country h. Outputs of Sector 1 and Sector 2 in country h can be found aggregating (9) over all industries:

$$Q_{h1} = \int_0^{\frac{1}{2}} Q_h(z)dz = \frac{n\left(a - \lambda_h\left[\theta w_h + w_f + \tau_{h1}\right]\right)}{b(2n+1)}; \tag{11}$$

$$Q_{h2} = \int_{\frac{1}{2}}^1 Q_h(z)dz = \frac{n\left(a - \lambda_h\left[w_h + \theta w_f + \tau_{h2}\right]\right)}{b(2n+1)}, \tag{12}$$

where $\tau_{h1} = \int_0^{\frac{1}{2}} \tau_h(z)dz$ and $\tau_{h2} = \int_{\frac{1}{2}}^1 \tau_h(z)dz$. This setup makes it easier to analyse the welfare effects of trade policy in general equilibrium. We next examine how a macro-blind policy maker would set trade policy.

3.1 The macro-blind policy maker

The welfare criterion used to determine trade policy at the sectoral level is often decomposed into the industry-level variables consumer surplus, tariff revenue, profits, and labour income. Total consumer surplus can be obtained by summing the surplus of each variety over all z:

$$CS_h = \int_0^1 \left[U(Q_h(z)) - P_h(z) Q_h(z)\right] dz.$$

Tariff revenue is simply equal to the sum of the revenues from taxing imports of each industry z:

$$TR_h = \int_0^1 \tau_h(z) q_{hf}(z) dz.$$

Aggregate profits in country h, denoted Π_h, can be found by summing (3) over all industries in both markets:

$$\Pi_h = \int_0^1 \left[P_h(z) - \theta_h(z) w_h\right] q_{hh}(z) dz + \int_0^1 \left[P_f - \theta_h(z) w_h - \tau_f(z)\right] q_{fh}(z) dz.$$

If we let L_h denote total labour supply in country h, the expression for aggregate labour income is the following:

$$l_h = w_h L_h. \tag{13}$$

Hence, the macro-blind policy-maker's objective function in h is:

$$\begin{aligned} W_h^{MB} &= CS_h + TR_h + \Pi_h + l_h \\ &= \int_0^1 U(Q_h(z)) dz - \int_0^1 \theta_h(z) w_h q_{hh}(z) dz + w_h L \\ &+ \int_0^1 \left[P_f(z) - \theta_h(z) w_h - \tau_f(z)\right] q_{fh}(z) dz - \int_0^1 \left[P_h(z) - \tau_h(z)\right] q_{hf}(z) dz \end{aligned} \tag{14}$$

This microeconomic objective function is the most common in literature on strategic trade policy. However, it is not a description of the true welfare in general equilibrium as will be discussed at length below. We believe that it is likely that real-world trade policy is conducted at the industry level by policy-makers that are likely to prioritise sector-specific interests rather than macroeconomic effects. As such, the welfare expression (14) might be the relevant one for most policy makers. As discussed in Baldwin and Venables (1995) and Mrazova (2009), it is possible to decompose the microeconomic welfare effects of an import tariff into a Terms-of-Trade (ToT) effect, a Volume-of-Trade (VoT) effect, and a Profit-shifting (PS) effect. Differentiating the welfare of country h in (14) with respect to the import tariff $\tau_h(z)$ yields:

$$\frac{dW_h^{MB}}{d\tau_h(z)} = \underbrace{-\frac{d\left(P_h(z) - \tau_h(z)\right)}{d\tau_h(z)} q_{hf}(z)}_{ToT \geq 0} + \underbrace{\tau_h(z) \frac{dq_{hf}(z)}{d\tau_h(z)}}_{VoT \leq 0} + \underbrace{\left(P_h(z) - \theta_h(z) w_h\right) \frac{dq_{hh}(z)}{d\tau_h(z)}}_{PS \geq 0}, \tag{15}$$

where $P_h(z) - \tau_h(z)$ is the mill price (net-of-tariff price) of country f's good. The ToT effect is the variation in the net-of-tariff price which country f's firms receive for their exports to country h. In this model, the ToT effect is positive such that an increase in country h's import tariff improves its terms of trade at the micro-level (ToT > 0). The tariff reduces country h's volume of trade (VoT < 0) due to a higher consumer price of imports, but it shifts profits from foreign exporters to domestic producers by reducing market access

(PS > 0). This last effect is due to the oligopolistic distortion where the import tariff moves domestic firms towards the Stackelberg leader output level. Plugging the Cournot quantities in (7) and (8), their derivatives and the inverse demand function (2) in (15), we can solve for the optimal non-cooperative tariff for country h and analogously for country f, as:

$$\tau_h^{MB}(z) = \frac{a\left[2(n+1)-\lambda_h\right] + n\lambda_h\theta_h(z)\left[1-\lambda_h\right]w_h - \lambda_h\theta_f(z)\left[(1+\lambda_h)n+1\right]w_f}{\lambda_h\left[n(2n+\lambda_h)+2(2n+1)\right]}; \tag{16}$$

$$\tau_f^{MB}(z) = \frac{a\left[2(n+1)-\lambda_f\right] + n\lambda_f\theta_f(z)\left[1-\lambda_f\right]w_f - \lambda_f\theta_h(z)\left[(1+\lambda_f)n+1\right]w_h}{\lambda_f\left[n(2n+\lambda_f)+2(2n+1)\right]}. \tag{17}$$

The tariffs have the property that they converge to zero as n goes to infinity. This is because when the number of firms increases, equilibrium outputs approach the level achieved under perfect competition, and thus there are no ToT or PS effects of trade policy. In the next section, we determine general equilibrium variables.

4 General equilibrium

In standard models of strategic trade policy, factor prices are exogenous. In our model, however, we allow these to be determined endogenously in general equilibrium. To solve for economy-wide wages, we use the following full-employment condition in country h:

$$L_h = \int_0^1 \theta_h(z)[q_{hh}(z) + q_{fh}(z)]dz, \tag{18}$$

and likewise, in country f:

$$L_f = \int_0^1 \theta_f(z)[q_{ff}(z) + q_{hf}(z)]dz. \tag{19}$$

We assume that $L_h = L_f = L$. Plugging (7) and (8) and their foreign equivalents into (18) and (19), and solving the two equations in the two unknowns w_h and w_f, respectively, yields:

$$w_h = \frac{na\left(\mu_h + \mu_f\right) - n\lambda_f T_f - bL\left(2n+1\right)}{n\left[\lambda_f\gamma + \lambda_h\psi_h\right]}; \tag{20}$$

$$w_f = \frac{na\left(\mu_h + \mu_f\right) - n\lambda_h T_h - bL\left(2n+1\right)}{n\left[\lambda_h\gamma + \lambda_f\psi_f\right]}, \tag{21}$$

where $T_h = \int_0^1 \theta_h(z)\tau_h(z)\,dz$ and $T_f = \int_0^1 \theta_f(z)\tau_f(z)\,dz$, respectively, are the weighted means of the two countries' respective industry-specific tariffs, $\mu_h = \int_0^1 \theta_h(z)dz$ and $\mu_f = \int_0^1 \theta_f(z)dz$ are the first moments of the two countries' respective productivity distributions, $\gamma = \int_0^1 \theta_h(z)\theta_f(z)dz$ is the covariance of the two countries productivity distributions, and $\psi_h = \int_0^1 \theta_h(z)^2dz$ and $\psi_f = \int_0^1 \theta_f(z)^2dz$ are the second moments (variances) of the two countries productivity distribution.

We assume that the two countries are symmetric, but this does not necessarily imply that they are identical. The symmetry assumption ensures that $\mu_h = \mu_f = \mu$, and $\psi_h = \psi_f = \psi$. Multiplying the home and foreign tariff, respectively, in (16) and (17) by $\theta_h(z)$ and $\theta_f(z)$, and integrating over all industries yields:

$$T_h^{MB} = \frac{a\left[2(n+1)-\lambda_h\right]+n\lambda_h\mu\left[1-\lambda_h\right]w_h-\lambda_h\mu\left[(1+\lambda_h)n+1\right]w_f}{\lambda_h\left[n(2n+\lambda_h)+2(2n+1)\right]}; \tag{22}$$

$$T_f^{MB} = \frac{a\left[2(n+1)-\lambda_f\right]+n\lambda_f\mu\left[1-\lambda_f\right]w_f-\lambda_f\mu\left[(1+\lambda_f)n+1\right]w_h}{\lambda_f\left[n(2n+\lambda_f)+2(2n+1)\right]}, \tag{23}$$

where the superscript MB is for macro blind. The symmetry assumption is useful because it allows us to further simplify our expressions. In particular, in a symmetric equilibrium, we must have $\lambda_h = \lambda_f$. Define $\lambda_h + \lambda_f = \overline{\lambda}$ as the 'world' marginal utility of income. We normalise such that $\overline{\lambda} = 1$. In a symmetric equilibrium, thus, we must have $\lambda_h = \lambda_f = \frac{1}{2}$. Using this, we can now solve for the economy-wide wage level by plugging (22) and (23) into, respectively, (20) and (21). This yields:

$$\overline{w}^{MB} = \overline{w}_h^{MB} = \overline{w}_h^{MB} = \frac{a\mu n\,(2n+3)-bL\left[n\,(2n+3)+2\,(n+1)\right]}{n\left[n\,(\gamma+\psi)+\gamma+2\psi\right]}. \tag{24}$$

In terms of our two-sector structure, we can rewrite (24) by using $\mu = \int_0^1 \theta(z)dz = \frac{1}{2}(1+\theta)$, $\psi = \int_0^1 \theta(z)^2 dz = \frac{1}{2}\left(1+\theta^2\right)$, and $\gamma = \int_0^1 \theta_h(z)\theta_f(z)dz = \theta$, such that,

$$\overline{w}^{MB} = \overline{w}_h^{MB} = \overline{w}_h^{MB} = \frac{an(1+\theta)(2n+3)-4bL(n^2+1)-10bLn}{\left[(n+1)(1+\theta^2-2n\theta)\right]\left[2n+3\right]n} \tag{25}$$

4.1 The omniscient policy-maker

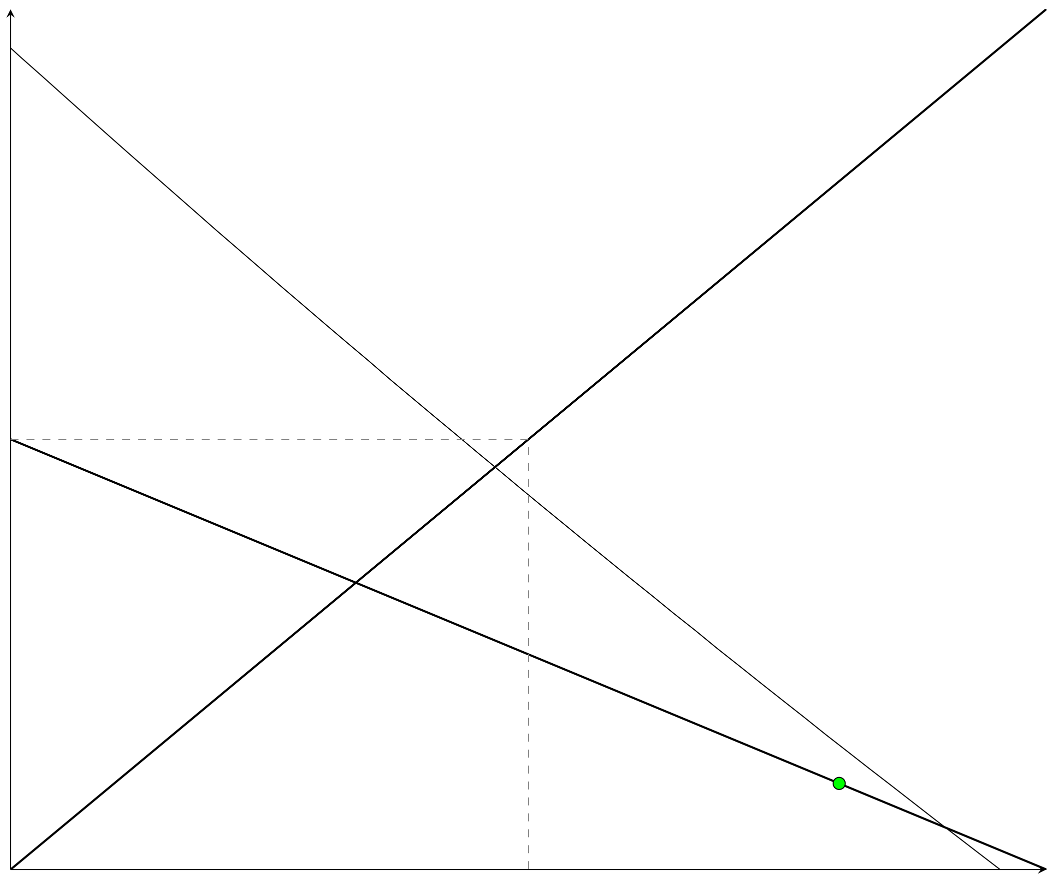
In the standard model of strategic trade policy, which ignores general-equilibrium effects through factor prices and income, it is not possible to study the economy-wide consequences of trade policy. We close this general equilibrium model by imposing a constraint which ensures balanced trade. The Balance of Trade (BoT) condition takes the following form:

$$\int_0^1 \left(P_h\left(z\right)-\tau_h\left(z\right)\right)q_{hf}\left(z\right)dz = \int_0^1 \left(P_f\left(z\right)-\tau_f\left(z\right)\right)q_{fh}\left(z\right)dz. \tag{26}$$

The BoT implicitly determines the Lagrange multipliers λ_h and λ_f. Their solutions, however, are indeterminate and a normalisation rule is thus necessary to close the model. We choose to normalise the model in terms of the sum of the two countries' Lagrange multipliers, such that $\lambda_h + \lambda_f = 2$. This normalisation rule is standard in GOLE. The omniscient policy-maker takes into account economy-wide variables such as the wages and income. The omniscient policy-maker in each country would like to set an import tariff such as to make its welfare as large as possible. Unlike a standard model of strategic trade policy, the maximisation problem needs to take the BoT into account. Using the full-employment conditions in (18) and (19) and the BoT condition in (26) in the expression for welfare in (14), yields:

$$W_h^O = \int_0^1 U(Q_h\left(z\right))dz. \tag{27}$$

Figure 1: This is the caption for the graph



This is indirect utility, and this is the expression which the omniscient policy-maker seeks to maximise: it is the true level of welfare in general equilibrium. The macro-blind policy maker's welfare expression in (14) ignores the impact of its actions on the economy-wide wage level as well as the trade balance.

As we have seen earlier, we can easily solve the full-employment conditions in terms of wages. It is then possible to substitute these wage expressions back into the expression for welfare in (27). It is less straightforward when it comes to the BoT constraint in (26) since this is an implicit function defined in terms of λ_h and λ_f. As it turns out, however, it is possible to obtain explicit closed-form solutions for tariffs in a version of the GOLE model with no productivity differences across sectors. The version of the GOLE model without any features is commonly referred to as the featureless GOLE model. We will begin by analysing the tariffs which obtain in this framework.

4.1.1 The featureless economy

In the featureless economy, the two sectors in the economy are identical. We maximise welfare in (27) subject to the BoT in (26). In Appendix A, we show that there is a solution to this problem given as:

$$\left(\tau_{h1}^O, \tau_{h2}^O \tau_{f1}^O, \tau_{f2}^O, \lambda_h, \lambda_f\right) = \left(\frac{bL}{n}, \frac{bL}{n}, \frac{bL}{n}, \frac{bL}{n}, 1, 1\right) \tag{28}$$

We can get an expression for the import quantities from (8). We sum over all industries in, say Sector 1, then substituting for the wages in, respectively (20) and (21), and then evaluating the resulting expression at the tariffs and Lagrange multipliers in (28), yields:

$$q_{hf1}^O = q_{hf2}^O = 0. \tag{29}$$

In words, the two omniscient policy makers, respectively, in the two countries set tariffs on each others' imports until trade is eliminated. In a featureless economy, however, there are no gains from trade, and as such this does not reduce welfare.

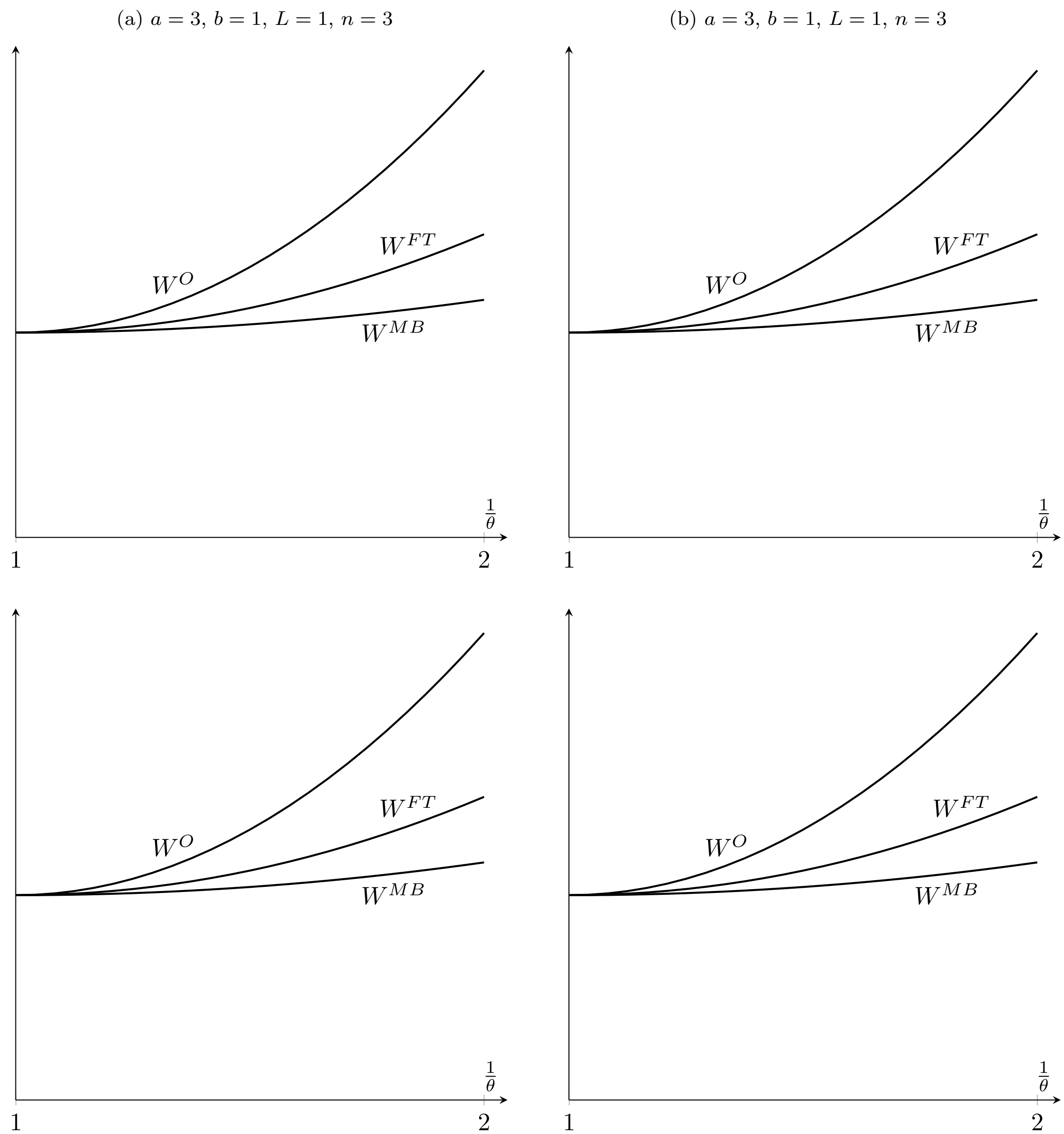
4.1.2 An Economy with features

We now reintroduce the features in the economy. Country h has a comparative advantage in Sector 1 and country f has a comparative advantage in Sector 2. We maximise welfare in (27) subject to the BoT in (26). We need an additional constraint in order to proceed – a constraint which ensures that the production of goods which are imported from an inefficient source is non-negative. Specifically, we need:

$$q_{hf1} \geq 0, \quad q_{fh2} \geq 0. \tag{30}$$

When we introduce features into the optimisation problem, it is no longer possible to obtain closed-form analytical solutions for tariffs. In this case, we need to simulate the solutions and the corresponding welfare effects. In Appendix B (to be included), we show how we obtain the import tariffs. We then evaluate welfare in (27) at these tariffs and compare the level of welfare obtained with tariffs set by the omniscient policy-maker with free trade and with the level of welfare obtained when tariffs are set by macro-blind policy-makers. We do this for specific parameter values in Figure 2. It is clear that if the government is able to apply the omniscient tariffs, then welfare is higher.

Figure 2: Simulation of welfare under different tariff regimes



5 Concluding remarks

By comparing a so-called macro blind policy-maker to an omniscient one, we have shown that a micro founded trade policy is insufficient. This is partly due to an effect recognised by Dixit and Grossman (1986), namely that any trade policy in one sector will lead to an change of factor demand and thus factor costs in all other sectors. However, this is only part of the story. A fully informed policy-maker will know that the only way to increase welfare if the world has a fixed aggregate production is to acquire consumption from the trade partner. This can be achieved through manipulating the foreign income and thus willingness to pay. GOLE is, to our knowledge, the only model that can capture this incentive, and thus provides us on new insight on the difference between a micro-founded trade policy and a trade policy set by a fully informed policy-maker.

Appendix A

We set up the Lagrangian for the optimisation problem for country h as follows:

$$\begin{aligned}\max_{\tau_h} \mathcal{L}_h = \int_0^1 V(Q_h) + \mu_1 \left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) \\ + \mu_2 \left(\int_0^1 P_h^*(z) \right) + \mu_3 \left(\int_0^1 P_f^*(z) dz \right)\end{aligned}$$

Similarly for country f:

$$\begin{aligned}\max_{\tau_f} \mathcal{L}_f = \int_0^1 V(Q_f) + \mu_4 \left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) \\ + \mu_5 \left(\int_0^1 P_h^*(z) \right) + \mu_6 \left(\int_0^1 P_f^*(z) dz \right)\end{aligned}$$

We can set up the following Kuhn-Tucker conditions for country h's optimisation problem:

$$\begin{aligned}
&\tau_h \frac{d\mathcal{L}}{d\tau_h} = 0 \quad \text{with} \quad \tau_h > 0, \quad \frac{d\mathcal{L}}{d\tau_h} = 0 \\
&\lambda_f \frac{d\mathcal{L}}{d\lambda_f} = 0 \quad \text{with} \quad \lambda_f > 0, \quad \frac{d\mathcal{L}}{d\lambda_f} = 0 \\
&\mu_1 \left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) = 0 \quad \text{with} \quad \mu_1 > 0, \\
&\left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) = 0 \\
&\mu_2 \left(\int_0^1 P_h^*(z) \right) \quad \text{with} \quad \mu_2 = 0, \quad \left(\int_0^1 P_h^*(z) \right) > 0 \\
&\mu_3 \int_0^1 P_f^*(z) dz \quad \text{with} \quad \mu_3 = 0, \quad \left(\int_0^1 P_f^*(z) \right) > 0
\end{aligned}$$

and similarly for country f:

$$\begin{aligned}
&\tau_f \frac{d\mathcal{L}}{d\tau_f} = 0 \quad \text{with} \quad \tau_f > 0, \quad \frac{d\mathcal{L}}{d\tau_f} = 0 \\
&\lambda_f \frac{d\mathcal{L}}{d\lambda_f} = 0 \quad \text{with} \quad \lambda_f > 0, \quad \frac{d\mathcal{L}}{d\lambda_f} = 0 \\
&\mu_4 \left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) = 0 \quad \text{with} \quad \mu_4 > 0, \\
&\left(\int_0^1 P_h^*(z) q_{hf}(z) dz - \int_0^1 P_f^*(z) q_{fh}(z) dz \right) = 0 \\
&\mu_5 \left(\int_0^1 P_h^*(z) \right) \quad \text{with} \quad \mu_5 = 0, \quad \left(\int_0^1 P_h^*(z) \right) > 0 \\
&\mu_6 \int_0^1 P_f^*(z) dz \quad \text{with} \quad \mu_6 = 0, \quad \left(\int_0^1 P_f^*(z) \right) > 0
\end{aligned}$$

There is only one real solution which satisfies all of these constraints and that is the one given in the text.

References

Baldwin, R. E., Venables, A. J., (1995). "Regional economic integration," Handbook of International Economics, in: G. M. Grossman and K. Rogoff (ed.), Handbook of International Economics, edition 1, volume 3, chapter 31, pages 1597-1644 Elsevier.

Brander J. A. (1981). Intra-industry trade in identical commodities. Journal of International Economics Vol.11, pp. 114

Brander J. A. (1995). Strategic trade policy, in Handbook of International Economics, Chapter 27. Vol.3, pp. 13951455 University of British Columbia

Brander J. A., Krugman, P. (1983). A reciprocal dumping model of international trade. Journal of International Economics. Vol. 15, pp. 313321

Brander J.A., Spencer B.J. (1981). Tariffs and the extraction of foreign monopoly rents under potential entry. Canadian Journal of Economics, Vol.14, pp. 371389

Brander J.A., Spencer B.J. (1985). Export subsidies and market share rivalry. Journal of International Economics, Vol.18, pp. 83100

Brander J.A., Spencer B.J. (1984). Trade warfare: Tariffs and cartels, Journal of International Economics. Vol. 16, pp. 227242

Colacicco, R.(2012): Strategic trade policy in general oligopolistic equilibrium, SSRN working paper

Dixit, A. K., Grossman, G. M. (1986). Targeted export promotion with several oligopolistic industries. Journal of International Economics. Vol. 21, pp. 233249

Eaton, J., K., S., and S., S. (2012). International Trade: Linking Micro and Macro. NBER Working Paper 17864.

Koska, O.A. and Sthler, F. (2011). Trade and Imperfect Competition in General Equilibrium, CESifo Working Paper Series 3543

Krugman, P. (1987). Is Free Trade Pass? The Journal of Economic Perspectives. Vol. 1, pp. 131-144

Neary, J. P. (2003a). Globalization and Market Structure. Journal of the European Economic Association, Vol.1, pp. 245-271.

Neary, J. P. (2003b). Competitive versus Comparative Advantage. The World Economy Vol. 26, pp. 457-470.

Neary, J. P. (2003c). The road less travelled: Oligopoly and competition policy in general equilibrium, in R. Arnott, B. Greenwald, R. Kanbur and B. Nalebuff (eds.): Economics for an Imperfect World: Essays in Honor of Joseph E. Stiglitz, MIT Press, 2003.

Neary, J. P. (2009). International trade in general oligopolistic equilibrium. June 2002, latest revision February 2009.

Neary, J. P. (2010). Two and a Half Theories of Trade. The World Economy. Volume 33, pp. 119

Zotti, J. and Locke B. (2012): Welfare-optimal trade and competition policies in small open oligopolistic economies, The Journal of International Trade and Economic Development: An International and Comparative Review,

References

Baldwin, R. E. and Venables, A. J. (1995). Regional economic integration. In Grossman, G. M. and Rogoff, K., editors, *Handbook of International Economics*, volume 3, chapter 31, pages 1597–1644. Elsevier.

Mrazova, M. (2009). Trade negotiations when market access matters. Technical report.